

We Claim:

- Sub 1. A method for labeling DNA strands, comprising the steps of:
- a. incubating said DNA strands with a halogenated deoxynucleotide triphosphate (HdNTP) and an enzyme that catalytically attaches the halogenated deoxynucleotide (HdN) of said HdNTP onto the 3'OH ends of said DNA strands; and
- b. reacting the resulting HdN-DNA strands with a labeled anti-halogenated deoxynucleotide (anti-HdN) antibody which specifically binds to said HdN.
2. The method of Claim 1 wherein said halogenated deoxynucleotide triphosphate is selected from the group consisting of brominated deoxyadenosine triphosphate; brominated deoxycytosine triphosphate; brominated deoxyguanosine triphosphate; brominated deoxyuridine triphosphate; brominated deoxythymidine triphosphate; iodinated deoxyadenosine triphosphate; iodinated deoxycytosine triphosphate; iodinated deoxyguanosine triphosphate; iodinated deoxyuridine triphosphate; and iodinated deoxythymidine triphosphate.
- Sub 3. The method of Claim 1 wherein said enzyme is selected from the group consisting of terminal deoxynucleotidyl transferase (TdT) and DNA polymerase.
4. The method of Claim 1 wherein said labeled anti-halogenated nucleotide (anti-HdN) antibody is selected from the group of fluorescently labeled anti-HdN monoclonal antibody; radiolabeled anti-HdN monoclonal antibody; peroxidase-labeled anti-HdN monoclonal antibody; chromophore labeled anti-HdN monoclonal antibody; fluorescently labeled anti-HdN polyclonal antibody; radiolabeled anti-HdN polyclonal antibody; peroxidase-labeled anti-HdN

polyclonal antibody; and chromophore labeled anti-HdN polyclonal antibody.

5. A method for labeling DNA strands, comprising the steps of:
- incubating said DNA strands with brominated deoxynucleotide triphosphate (BrdNTP) and an enzyme that catalytically attaches the brominated deoxynucleotide (BrdN) of said BrdNTP onto the 3'OH ends of said DNA strands; and
  - reacting the resulting BrdN-DNA strands with a labeled anti-brominated deoxynucleotide (anti-BrdN) antibody which specifically binds to said BrdN.
6. The method of Claim 5 wherein said brominated deoxynucleotide triphosphate is selected from the group consisting of brominated deoxyadenosine triphosphate; brominated deoxycytosine triphosphate; brominated deoxyguanosine triphosphate; brominated deoxyuridine triphosphate; and brominated deoxythymidine triphosphate.
7. The method of Claim 5 wherein said enzyme is selected from the group consisting of terminal deoxynucleotidyl transferase (TdT) and DNA polymerase.
8. The method of Claim 5 wherein said labeled anti-brominated nucleotide (anti-BrdN) antibody is selected from the group of fluorescently labeled anti-BrdN monoclonal antibody; radiolabeled anti-BrdN monoclonal antibody; peroxidase-labeled anti-BrdN monoclonal antibody; chromophore-labeled anti-BrdN monoclonal antibody; fluorescently labeled anti-BrdN polyclonal antibody; radiolabeled anti-BrdN polyclonal antibody; peroxidase-labeled anti-BrdN polyclonal antibody; and chromophore labeled anti-BrdN polyclonal antibody.

9. A method for labeling DNA strands, comprising the steps of:
  - a. incubating said DNA strands with brominated deoxy-uridine triphosphate (BrdUTP) and an enzyme that catalytically attaches the brominated uridine (BrdUrd) of said BrdUTP onto the 3'OH ends of said DNA strands; and
  - b. reacting the resulting BrdUrd-DNA strands with a labeled anti-brominated uridine (anti-BrdUrd) antibody which specifically binds to said BrdUrd.
10. The method of Claim 9 wherein said enzyme is selected from the group consisting of terminal deoxynucleotidyl transferase (TdT) and DNA polymerase.
11. The method of Claim 9 wherein said anti-brominated uridine (anti-BrdUrd) antibody is selected from the group of fluorescently labeled anti-BrdUrd monoclonal antibody; radiolabeled anti-BrdUrd monoclonal antibody; peroxidase-labeled anti-BrdUrd monoclonal antibody; chromophore labeled anti-BrdUrd monoclonal antibody; fluorescently labeled anti-BrdUrd polyclonal antibody; radiolabeled anti-BrdUrd polyclonal antibody; peroxidase-labeled anti-BrdUrd polyclonal antibody; and chromophore labeled anti-BrdUrd polyclonal antibody.
12. A method for detecting breaks in DNA strands, comprising the steps of:
  - a. incubating said DNA strands with brominated deoxy-uridine triphosphate (BrdUTP) and an enzyme that catalytically attaches the brominated uridine (BrdUrd) of said BrdUTP onto the 3'OH ends of said DNA strands;

- b. reacting the resulting BrdUrd-DNA strands with a labeled anti-brominated uridine (anti-BrdUrd) antibody which specifically binds to said BrdUrd; and
  - c. detecting said label.
13. The method of Claim 12 wherein said enzyme is selected from the group consisting of terminal deoxynucleotidyl transferase (TdT) and DNA polymerase.
14. The method of Claim 12 wherein said labeled anti-brominated uridine (anti-BrdUrd) antibody is selected from the group of fluorescently labeled anti-BrdUrd monoclonal antibody; radiolabeled anti-BrdUrd monoclonal antibody; peroxidase-labeled anti-BrdUrd monoclonal antibody; chromophore labeled anti-BrdUrd monoclonal antibody; fluorescently labeled anti-BrdUrd polyclonal antibody; radiolabeled anti-BrdUrd polyclonal antibody; peroxidase-labeled anti-BrdUrd polyclonal antibody; and chromophore labeled anti-BrdUrd polyclonal antibody.
15. The method of Claim 12 wherein said labeled anti-brominated uridine (anti-BrdUrd) antibody is selected from the group of fluorescently labeled anti-BrdUrd monoclonal antibody and fluorescently labeled anti-BrdUrd polyclonal antibody, and said detecting is accomplished by a method selected from the group of flow cytometry, fluorescence microscopy, multiparameter laser scanning microscopy, and visual observation during irradiation with light of the excitation wavelength.
16. The method of Claim 12 wherein said labeled anti-brominated uridine (anti-BrdUrd) antibody is selected from the group of radiolabeled anti-BrdUrd monoclonal antibody and radiolabeled anti-BrdUrd polyclonal antibody, and said detecting is accomplished by a method

selected from the group of scintillation counting, autoradiography, and geiger counting.

17. A method for detecting whether cells have undergone apoptosis, comprising the steps of:
  - a. Fixing said cells;
  - b. incubating said cells with brominated deoxyuridine triphosphate (BrdUTP) and an enzyme that catalytically attaches the brominated uridine (BrdUrd) of said BrdUTP onto the 3'OH ends of DNA strands in said cells;
  - c. reacting the resulting BrdUrd-DNA strands with a labeled anti-brominated uridine (anti-BrdUrd) antibody which specifically binds to said BrdUrd; and
  - d. detecting said label, wherein apoptosis is confirmed by the detection of label at a level more than about two standard deviations above the mean level of label found in identically treated control samples known not to have undergone apoptosis.
18. The method of Claim 17 wherein said enzyme is selected from the group consisting of terminal deoxynucleotidyl transferase (TdT) and DNA polymerase.
19. The method of Claim 17 wherein said labeled anti-brominated uridine (anti-BrdUrd) antibody is selected from the group of fluorescently labeled anti-BrdUrd monoclonal antibody; radiolabeled anti-BrdUrd monoclonal antibody; peroxidase-labeled anti-BrdUrd monoclonal antibody; chromophore labeled anti-BrdUrd monoclonal antibody; fluorescently labeled anti-BrdUrd polyclonal antibody; radiolabeled anti-BrdUrd polyclonal antibody; peroxidase-labeled anti-BrdUrd polyclonal antibody; and chromophore labeled anti-BrdUrd polyclonal antibody.
20. The method of Claim 17 wherein said labeled anti-brominated uridine (anti-BrdUrd) antibody is selected

from the group of fluorescently labeled anti-BrdUrd monoclonal antibody and fluorescently labeled anti-BrdUrd polyclonal antibody, and said detecting is accomplished by a method selected from the group of flow cytometry, fluorescence microscopy, multiparameter laser scanning microscopy, and visual observation during irradiation with light of the excitation wavelength.

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